PORTO RICO AGRICULTURAL EXPERIMENT STATION
MAYAGUEZ, PORTO RICO
Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

## BULLETIN No. 32

# EFFECT OF TOPPING ON YIELD OF COFFEE IN PORTO RICO

BY

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Issued June, 1928

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON
1928

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[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture]

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# EFFECT OF TOPPING ON YIELD OF COFFEE IN PORTO RICO[1]

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The question of the advisability of topping coffee trees has recently received considerable attention from coffee growers in Porto Rico. The practice varies in different countries. In Colombia and Guadeloupe, for instance, heading back of coffee trees is universally practiced, whereas in Porto Rico the trees are allowed to attain full height.

## COFFEE BRANCHES

Dimorphism of branches must be taken into account in any system of pruning coffee. The subject has been treated at length by Cook.[2] A knowledge of the habit of growth of the coffee tree and of the differences between the kinds of branches is essential to a proper understanding of any pruning system practiced.

The coffee seedling first produces a single upright stem. When the stem is approximately a foot high, further elongation is accompanied by the development of lateral branches. A pair arises from extra-axillary buds at the base of the topmost internode, and the three stems—the upright and the two laterals—elongate simultaneously.

[1] In this bulletin the term "coffee" refers to the common type of *Coffea arabica* only, some other species of the genus Coffea requiring wholly different treatment from that recommended for Arabian coffee.

[2] Cook, O. F. Dimorphic branches in tropical crop plants: cotton, coffee, cacao, the central american rubber tree, and the banana. U. S. Dept. Agr., Bur. Plant Indus. Bul. 198, 64 p., illus. 1911.

(Fig. 1.) Thereafter a pair of laterals will develop in like manner at the base of most new internodes of the upright stem as this continues growth, but occasionally one or more internodes may be skipped or a single lateral may develop instead of a pair. If a primary


FIG. 1.—A, simultaneous development of the primary lateral branches and the upright stem; B, position of new uprights, developed from buds immediately below the primary laterals

lateral be removed the loss is permanent, as the upright stem can replace no lost lateral. However, in the axils of the leaves and just below each lateral branch on the upright stem are buds from which there may develop new upright branches similar in structure and habit of growth to the original stem. In this way only can addi-

tional primary laterals be produced. The normal function of lateral branches is to produce fruit and only occasionally is any fruit produced on an upright stem. In addition to producing fruit, primary laterals may also produce from axillary buds secondary lateral branches, which are similar in function to the primaries.

When growth is allowed to take its normal course, the original upright trunk bends under the weight of a heavy crop and various new upright branches develop from the axillary buds. These are similar in structure to the original stem, developing primary laterals, which in turn produce fruit. The tendency to develop secondary laterals varies somewhat with the variety, but on ordinary Arabian coffee, the growth of which has been unchecked by topping, the amount of secondary lateral growth is not very great. In consequence, by far the larger part of the crop is normally produced on primary rather than on secondary laterals. If upward growth is checked by topping and by the removal of new uprights as they appear, the production of secondary laterals on the primaries is greatly stimulated, and a large amount of such growth develops.

For all practical purposes only flowers, fruit, and secondary lateral branches may be expected to develop from the primary laterals, though observations at the station revealed two instances in which this failed to hold true. A tree which was topped at 4 feet in December, 1910, and the growth of which was forced into the laterals by the removal of all subsequently developing uprights, was observed in May, 1916, to have developed three "upright" branches from near the tip of a primary lateral. Their structure was that of the upright, not the lateral, and their lateral branches were in pairs and arose from extra-axillary buds. The position of these "upright" branches was more nearly horizontal than perpendicular and one showed a marked tendency to produce laterals in a somewhat horizontal plane. In 1918 a second tree was noted with several similar uprights arising from a lateral. These uprights were rather spindling and lacked the vigor of the normal upright. Although in the case of neither tree was the development that of the wholly normal or typical upright, it partook more of the nature of the upright than of the lateral.

## TREATMENT

The field selected for testing the effect of topping contained 161 trees at the beginning of the experiment in December, 1910. These had been set in the summer of 1908. The size of the seedlings at transplanting time was such as to indicate that the seed had been derived presumably from the 1906 crop. The variety was Blue Mountain of Jamaica, typical of the ordinary *Coffea arabica* and indistinguishable in appearance and habit of growth from the Porto Rican variety.

The trees were set in 24 short rows of unequal length. Rows 1 and 2 were left untopped, rows 3 and 4 were topped at 6 feet, and rows 5 and 6 at 4 feet. In the same alternating sequence the remaining 18 rows were similarly treated. The first of each of the four pairs of untopped rows received no pruning whatever, all suckers and growth

of every kind being allowed to develop freely. In the second row in contrast to the first, all uprights or suckers developing along the main stem were removed, thus holding the growth to the single original stem or trunk and developments from its laterals.

FIG. 2.—Coffee tree which carried 42 branches and more than 1,500 cherries. Photographed in September, 1910, prior to pruning

Topping forced the growth of many new uprights or suckers. These were removed from time to time, thus holding the growth to the single-topped stem and branches developing from the laterals. The first pruning was given in December, 1910. During the next six years the suckers were removed from the trees from 3 to 5 times annually, and during the following five years from 2 to 3 times annually.

The trees were young when they were topped and therefore well supplied with primary laterals. Figure 2 shows the condition of one of the better developed trees several months before the first pruning. This tree was 8 feet high and carried 42 lateral branches, the middle ones being more than 3 feet long. Some other trees had developed less rapidly and at the time of the first pruning lacked the necessary height for topping. These were subsequently topped as their growth permitted.

## EFFECT OF TOPPING AND REMOVAL OF SUCKERS

The appearance of the topped trees at four years after topping is shown in Figures 3 and 4. The dense mass of foliage is attractive to the eye. The picking of the crop is greatly facilitated through the production of the fruit on low branches within easy reach of the pickers.

The yield of the trees was recorded over a 10-year period, 1912–1921, the first record being taken at a little less than two years after the first pruning. The depressing effect on production exercised by severe pruning or topping was less evident in the early years of the test than later. In the three-year period, 1912–1914, both the trees

FIG. 3.—Topped at 6 feet December, 1910, and photographed August, 1914

which were held to a single trunk and those which were topped at 6 feet produced each year within 10 per cent of the production of the unpruned trees. Table 1 shows the average annual production of coffee cherries per tree as affected by pruning for the period 1912–1921.

TABLE 1.—*Effect of pruning on yield of coffee cherries per tree* [1]

| Treatment of trees | Average production in— | | | Total production 1912–1914 | Average production 1912–1914 | Average production in— | | | | | | | Total production 1915–1921 | Average production 1915–19 [1] | Production for period 1912–1921 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1914 | | | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | | | Total | Average |
| | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* | *Liters* |
| Unpruned | 2.0 | 2.3 | 2.6 | 6.9 | 2.3 | 4.6 | 2.0 | 4.2 | 1.3 | 4.8 | 1.2 | 2.8 | 20.9 | 3.0 | 27.8 | 2.8 |
| Untopped, single trunk | 2.2 | 2.5 | 2.7 | 7.4 | 2.5 | 3.0 | 1.4 | 3.1 | .9 | 3.1 | .5 | 1.2 | 13.2 | 1.9 | 20.6 | 2.1 |
| Topped at 6 feet | 1.9 | 2.4 | 2.4 | 6.7 | 2.2 | 3.0 | 1.6 | 2.8 | .9 | 3.0 | .9 | 1.6 | 13.8 | 2.0 | 20.5 | 2.1 |
| Topped at 4 feet | 1.7 | 1.9 | 2.4 | 6.0 | 2.0 | 2.0 | 1.3 | 2.1 | .5 | 2.2 | .8 | 1.2 | 10.1 | 1.4 | 16.1 | 1.6 |
| YIELD OF PRUNED TREES IN PERCENTAGE OF UNPRUNED TREES | | | | | | | | | | | | | | | | |
| | *Per cent* | *Per cent* | *Per cent* | *Per cent* | | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* | | *Per cent* | |
| Untopped, single trunk | 110 | 109 | 104 | 107 | | 65 | 70 | 74 | 69 | 65 | 42 | 43 | 63 | | 74 | |
| Topped at 6 feet | 95 | 104 | 92 | 97 | | 65 | 80 | 67 | 69 | 63 | 75 | 57 | 66 | | 74 | |
| Topped at 4 feet | 85 | 83 | 92 | 87 | | 43 | 65 | 50 | 38 | 46 | 67 | 43 | 48 | | 58 | |

[1] The number of trees included for averaging the annual yields varied somewhat from year to year. The range for each group was as follows: Unpruned trees, 22 to 27; untopped, single trunk, 25 to 30; topped at 6 feet, 45 to 51; and topped at 4 feet, 39 to 44. Trees which were accidentally broken had to be eliminated either permanently or until such time as their condition approximated that of the others in their group. Some of the trees died and had to be replaced, but no replacements under 6 years of age or within 3 years after setting were included.

For the three-year period as a unit the production of the trees which were held to a single trunk and those which were topped at 6 feet differed from that of the unpruned trees by 7 and 3 per cent. The difference in yield between the trees which were topped at 4 feet, however, and the unpruned trees was 13 per cent in favor of the unpruned trees.

The record of production for the seven following years showed the depressing effect of heavy pruning to be cumulative. For this period the trees which were held to a single trunk and those topped at 6 feet produced only two-thirds as much as the unpruned trees, whereas those that were topped at 4 feet produced slightly less than half as

FIG. 4.—Foreground, trees topped at 4 feet December, 1910, and photographed September, 1914

much as the check. For the 10-year period as a whole the trees which were held to a single trunk and those topped at 6 feet produced only 74 per cent as much as the unpruned trees, and those which were topped at 4 feet produced only 58 per cent as much. The production is shown graphically in Figure 5.

## CONCLUSIONS

Topping coffee trees considerably facilitates collection of the crop and also contributes to the uniform and well-kept appearance of the plantation, but these advantages are gained at the expense of yield. Such minor benefits compensate in only a small degree for the heavy loss of crop entailed.

The normal production of coffee is largely upon primary laterals. The tree is constantly producing new upright branches bearing pri-

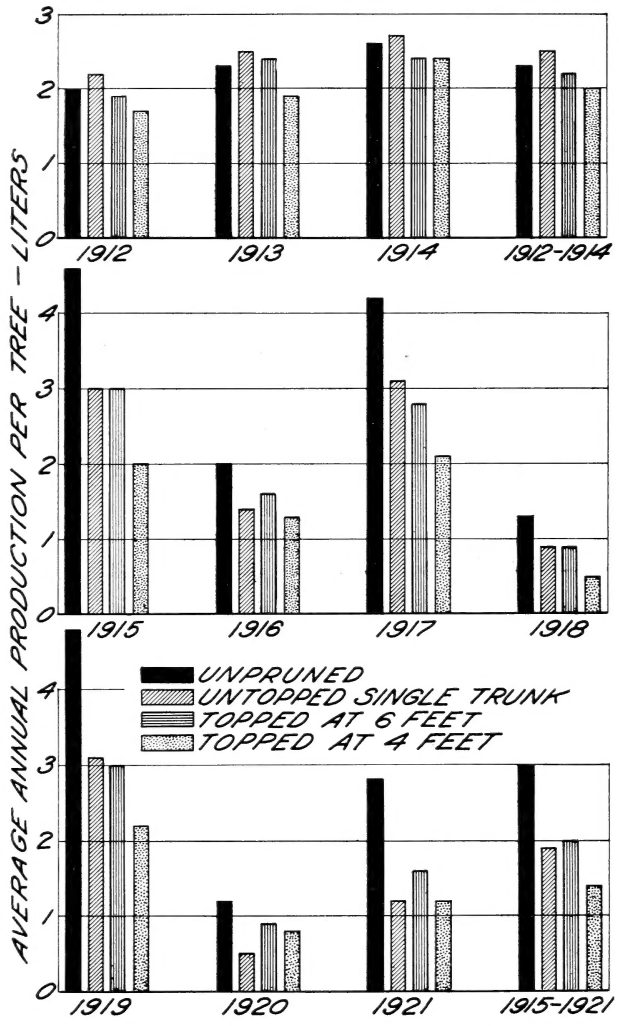


FIG. 5.—Average annual production of coffee cherries per tree as affected by pruning

mary laterals. If the tree is topped and these new uprights or suckers are removed altogether, the growth of secondary laterals is forced and future crop production is from them rather than from primary laterals, with a resultant curtailment of crop. The development of new uprights is essential for a maximum crop. Although in the test recounted the wholly unpruned trees gave the highest production, the inference that no pruning is advisable should not be made. Ordinarily, suckers are produced in such numbers as to make the removal of some of them advantageous to the best development of the tree. The strongest and best-located suckers well distributed over the tree should be left. The removal of the weaker suckers and those which crowd the better ones aids the development of the latter. Each tree presents an individual problem, and the number of suckers which should be left varies with the development and condition of the tree.

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